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Amino Acid and Mineral Compositions of Raw and Treated *Moringa oleifera* Seed

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Abstract

The study evaluated the amino acid profile and mineral composition of *Moringa oleifera* seed meal. A combination of boiling for 90 minutes and soaking for 72 hours was employed in the treatment of Moringa seed. Eighteen amino acids were found, ten essential and eight non-essentials in the four feed ingredients. Significantly ($p<0.05$) lower values were recorded in five essential amino acids (leucine, lysine, methionine, threonine and valine) in treated Moringa seed than the fish meal. A total of nine minerals were detected in the raw and treated samples, and the treatment affected their availability differently. These results suggest the potential of the seeds as a source of amino acids and minerals that could be tested as a substitute for fish meal.

Keywords:
Concentration; seed meal; essential; non-essential; protein

Introduction

Feed cost is known to account for over two third of the variable cost of an intensive aquaculture system (Aderolu and Sogbesan, 2010). Therefore, knowledge of nutrition and practical feeding of fish is essential to successful aquaculture. Aqua culturists have therefore, begun to evaluate alternative diet ingredients to replace fishmeal with readily available inexpensive plant sources. Considerable emphasis has been focused on the use of conventional plant protein sources, such as soybean (Sadiku and Jauncey, 1995), groundnut and rapeseed meal (Jackson *et al.,* 1982), and cottonseed (El-Sayed, 1999) to replace fishmeal in the diet of fish. However, their scarcity and competition from other sectors for livestock and human consumption as well as industrial use make their costs too high and put them far beyond the reach of fish farmers or producers of aqua feeds (Fasakin, 1997).

It is therefore necessary to resourcefully search, explore, identify and utilize other plant protein sources such as *Moringa oleifera* seed, which could be cheaper, less competitive, not relatively in high demand and resistant to drought; compared to fishmeal which is expensive and highly competitive in utilization. It holds a considerable potential for becoming an ingredient for animal and fish because of its high nutritional quality that is comparable to other feed protein sources (Becker, 2003). The objective of this study was to evaluate the amino acid and mineral profiles of *Moringa oleifera* seed meal.

Materials and Methods

Sample Collection and Preparation

Dried mature fruits of *Moringa oleifera* were obtained from Maiyafe farm at *Kududdufawa* in Ungoggo Local Government, Kano State, on latitude 12° 05' 26° N and longitude 8° 29'48° E. The seed samples

were cleaned thoroughly to remove dirt, stones and deteriorated seed. Fish meal, blood meal and ground nut cake were obtained from No. 147/148; Mission road, Bompai, Kano, and analysed for comparison with the Moringa seed meal.

Processing of Moringa oleifera Seeds

The moringa seeds were processed following methods of Haruna *et al*. (2018), in which the seeds were boiled for 90 minutes and soaked for 72 hours and the treated sample was further analysed for amino acid profile and mineral composition.

Determination of Amino Acid Profile

The amino acid profile of the treated and untreated Moringa seeds were determined at the Laboratory of Zoology Dept. University of Jos, using methods described by Spackman *et al.* (1958) as modified by Benitez (1989) and AOAC (2006). The dried and milled flour samples were defatted, hydrolysed, evaporated in a rotary evaporator and then loaded into the Technicon Sequential Multi-Sample Amino Acid Analyzer (TSM). Each of the defatted samples was weighed (200 mg) into a glass ampoule, 5 ml of 6 mol/L HCl was added and the contents hydrolyzed in an oven preset at 105 ± 5°C for 22 hour. Oxygen was expelled in the ampoule by passing nitrogen gas into it. Amino acid analysis was done by ion-exchange chromatography (Spackman *et al.,* 1958) using a Technicon Sequential Multisample Amino Acid Analyzer (Technicon Instruments Corporation, New York, NY). The period of analysis was 76 min, with a gas flow rate of 0.50 mL/min at 60°C, and the reproducibility was ±3%. The amino acid composition was calculated from the areas of standards obtained from the integrator and expressed as percentages of the total protein.

Mineral Determination

The mineral elements evaluated were calcium, copper, phosphorus, sodium, magnesium, zinc, iron and potassium. The evaluation of potassium and sodium components were performed using flame photometry (Jenway Limited, Donmow Essex, UK), while phosphorus was analysed by means of vanado-molybdate method (AOAC, 2006).

Results

Amino Acid Compositions of the Seed Meal

The amino acid profiles of the raw and treated seed meal are presented in Table 1. Eighteen amino acids were found, ten essential and eight non-essential in the four feed ingredients. Appreciable quantities of essential amino acids with the exception of methionine and tryptophan were observed in the raw and treated samples with consistent higher values in the treated samples. The concentration of essential amino acid was arginine (8.13±0.10), isoleucine (4.50±0.13), leucine (5.69±0.27), lysine (3.75±0.06), methionine (1.22±0.15), phenylalanine (4.46±0.04) and tryptophan (1.67±0.04) were significantly ($p<0.05$) higher in the treated than raw samples.

Table 1: Amino acid compositions of raw and treated (B90mins/S72hrs) *Moringa oleifera* seed meal and some feed ingredients

Amino acids	Raw MSM	Treated MSM
Essential Amino Acids		
Arginine	7.88±0.18^{c}	8.13±0.10^{b}
Histidine	2.07±0.11^{c}	2.24±0.10^{bc}
Isoleucine	4.10±0.23^{b}	4.50±0.13^{a}
Leucine	5.35±0.15^{d}	5.69±0.27^{c}
Lysine	3.33±0.15^{e}	3.75±0.06^{d}
Methionine	0.96±0.05^{c}	1.22±0.15^{b}
Phenylalanine	4.28±0.13^{d}	4.46±0.04^{c}
Threonine	3.36±0.11^{b}	3.51±0.04^{b}
Tryptophan	1.51±0.10^{b}	1.67±0.04^{a}
Valine	3.09±0.14^{d}	3.23±0.07^{d}
Non-Essential Amino Acids		
Alanine	3.32±0.17^{d}	3.52±0.03^{cd}
Aspartic acid	6.46±0.50^{c}	6.00±0.05^{c}
Cystine	1.05±0.10^{c}	1.26±0.06^{b}
Glutamic acid	13.88±0.38^{b}	13.33±0.14^{c}
Glycine	5.02±0.18^{b}	5.08±0.13^{b}
Proline	2.57±0.24^{c}	2.64±0.14^{c}
Serine	4.24±0.16^{b}	4.60±0.02^{a}
Tyrosine	2.23±0.18^{c}	2.71±0.09^{b}

Mean value with same letter in row were not significant ($p>0.05$). MSM = Moringa seed meal

Mineral Composition of Treated Seed Meal

Results in Table 2 indicated a significant difference ($p<0.05$) in the analysis on the raw and treated seeds. A total of nine minerals were detected comprising of five macro minerals (magnesium, sodium, potassium, phosphorous and calcium) and four micro minerals (iron, zinc, manganese and copper). The raw samples had higher values in three macro minerals, sodium, potassium and calcium as well as three micro minerals iron zinc and copper while the treated and defatted Moringa sample had higher values in two macro minerals, magnesium and phosphorus and single micro mineral, manganese. The results indicated that processing (B90mins/S72hrs) affected availability of the mineral contents of Moringa seed meal differently. Two macro minerals, magnesium and phosphorus, and one micro mineral, manganese were significantly ($p<0.05$) increased while three macro minerals, sodium, potassium and calcium, and three micro minerals were significantly ($p<0.05$) reduced.

Table 2: Mineral compositions of raw and treated (B90min/S72hrs) *Moringa oleifera* seed meal

Minerals	Raw (mg/100g)	Treated (mg/100g)
Magnesium	353.50±5.68^{b}	798.00±2.64^{a}
Sodium	1528.00±2.0^{a}	23.95±0.06^{b}
Potassium	3400±0.00^{a}	70.31±0.27^{b}
Iron	80.40±0.53^{a}	20.82±0.28^{b}
Zinc	6.81±0.52^{a}	2.47±0.06^{b}
Manganese	11.37±0.12^{b}	56.2±0.40^{a}
Copper	7.16±0.03^{a}	0.00±0.00^{b}
Phosphorus	72.33±2.52^{b}	325.33±0.58^{a}
Calcium	365.17±2.05^{a}	111.72±0.03^{b}

Mean values with same letter in row were not significantly different ($p>0.05$)

Discussion

The result in this study indicated that the concentration of the essential amino acids of the treated samples with the exception of tryptophan (1.67±0.04) and methionine (1.22±0.15) were higher than the recommended requirement for *C. gariepinus* (Fagbenro *et al*., 1999; Pantaziz, 1999). Earlier results of the treated protein and ash levels revealed the protein content was 55.05±0.16 and ash content was 6.01±0.10 (Haruna *et al.,* 2018).

The essential amino acids of the treated Moringa seed were higher than that of the raw sample (Table 1). This observation indicates that boiling for 90mins and soaking for 72hrs increased the essential amino acid content of Moringa seed. This finding is in agreement with that of other investigators who reported that both germination and fermentation processing methods increased the protein and amino acid profile of food samples (Cronk *et al*., 1977; Dubey *et al.,* 2008).

Methionine and lysine are known to be the limiting amino acids in vegetable/plant materials as revealed for Moringa in this study. This supports the finding of Oluwole *et al*., (2013) who reported lysine and methionine as the first and second limiting amino acids in Moringa seed flour, respectively. The lysine and methionine are very important in fish feed ingredients because they are the two first limiting amino acids in plant feed stuff (Aderolu *et al.,* 2011).

The result of this study showed that boiling for 90mins and soaking for 72 hrs and defatting affected the mineral contents differently (Table 2). While it significantly ($p<0.05$) increased the contents of magnesium, manganese and phosphorus, it lowers the values of sodium, potassium, iron, zinc, copper and calcium. Wang *et al.,* (2010) reported similar result when beans and chicken peas were subjected to cooking. Cooking in water was reported by Haytowitz and Matthews (1983) to cause reduction in some minerals of cooked pulse.

The Na content was also higher than the value (8.42 mg/100g) reported by Adubiaro *et al.* (2011) for baobab seed while the Ca, K, Fe and Mg contents were higher than that of moringa seeds. Differences observed between results can be attributed to geographical, soil composition, cultivation, climate, ripening stage, the harvesting time of the seeds and the oil extraction method used Compaoré *et al*. (2011).

Conclusion

In view of the favourable amino acid profile of *Moringa oleifera* seed and their wide availability throughout the tropics and subtropics, it can be considered as a possible feed component in fish feed.

However, the two limiting amino acids (methionine and lysine) indicated the need for supplementation with other ingredients that are rich in these two essential amino acids. Further investigation on the use of this seed meal as substitute to fish meal is desirable.

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